# Soil Report for the 2013 Mountain Fire
# San Bernardino National Forest

**Resource Specialty:** Soil
**Fire Name:** Mountain, San Bernardino National Forest
**Incident #:** CABDF-010328
**Month and Year:** July, 2013
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## Objectives

- Quantify erosion potential.
- Assess post-fire soil conditions, particularly those that pose substantial threats to human life, property, and soil productivity.
- Identify values at risk downstream and down slope from the high and moderate severity burn areas.
- Recommend treatments where appropriate.

The purpose of the post-fire assessment is to analyze fire effects on soils and watersheds, determine potential for negative effects, and consider possible treatment options. The potential threat to life and property are always the number one concern and is the first focus of the burned area assessment.

## Initial Concerns

- Threats to human life and property within and downstream of the burn area from flooding and debris slides.
- Threats to soil productivity and water quality in severely burned areas.

Soil productivity, water quality, property, and life are potential values at risk when wildfire burns through an area followed by large storms, particularly during the first and second year following the Fire. The loss of natural vegetative cover allows water to runoff across bare soils with increased velocity. Fire also induces water repellency of varying degrees, reducing water infiltration, and increasing runoff. The net result under extreme conditions is a loss of soil, a loss of water control, and significant risk of flooding and debris flows downstream of the fire.

## Resource Setting

The resource setting is that of very steep chaparral and forest covered mountain slopes between Palm Springs and Idyllwild, CA.
Soils in this area are derived dominantly from granodiorite and other granitics on hillslopes, and are formed on alluvial deposits in valley bottoms. Soil depth is generally

moderately deep with rock outcrops on the west side of the San Jacinto mountain range, and the east side is dominated by rock outcrop and shallow soils. Soils formed from other geology, including metasedimentary or metamorphic roof pendants make up only minor portions of the fire area. Soil textures are keyed to geology; coarse sandy loams or loamy sands are associated with granitic rocks, and fine sandy loams and gravely deposits are found on alluvium. The dominant soil map units within the fire are: Rock outcrop (37%); Lithic Xerorthents-Rock outcrop complex, 50 to 100 percent slopes (19%); Rock outcrop, 30 to 100 percent slopes (13%); Wapi-Pacifico families, dry-Rock outcrop complex, 15 to 30 percent slopes (6%).

## Observation and Findings

The BAER Team began the limited BAER watershed survey on Thursday, July 25, 2013 by initiating a helicopter recon flight. Aerial video footage of the burned area was taken. The reconnaissance flight and video was used to refine the BARC (Burn Area Reflectance Classification) map and field evaluations were undertaken to ground truth the product. Throughout the survey the soil scientist and other team members continued to validate the map.

During field surveys, soil conditions were described, post-fire resource damage conditions were noted, and threats to soil productivity were determined. The magnitude and longevity of fire-related soil effects may be generally inferred from the soil burn severity rating. A low rating indicates short-term soil effects. These areas of low soil burn severity are generally not considered significant sediment source areas, and do not constitute a potential fire-caused emergency. A high rating may indicate rather severe and long-term effects.

**Burn Severity:**
The overall soil burn severity in the Mountain Fire is 14% unburned/very low, 36% low, 49% moderate, and 1% high. Appendix B is a map of soil burn severity within the fire perimeter . Soils with low burn severity still have good surface structure, contain intact fine roots and organic matter, and should recover in the short-term once re-vegetation begins and the soil surface regains cover. The moderate to high classes have evidence of severe soil heating in isolated patches; these areas have a significant loss of organic soil cover, and surficial char with partial destruction of structure, porosity, and roots. The most severely burned areas occurred on steep slopes at higher elevations and mostly under conifer forests or dense oak & riparian vegetation where pre-fire vegetation density and fuels accumulations were higher.

It should be noted that the moderate and high soil burn severity acres (shrub-chaparral vegetation) tend to behave or have a similar hydrologic response because protective ground cover is generally lacking before the first damaging storm event.

Hydrophobic soils were found in approximately 41% of the fire, or over 11,220 acres. The hydrophobic layer was commonly found beneath the ash layer and was 2-3 inches deep. Only moderate water repellency was found in the fire– with a water drop

test, water would stay on the soil surface for ~30 seconds to 1 minute. Interestingly, below the 2-3 inch layer, soils were always moist Table 1 summarizes soil burn severity acres for the Mountain Fire.

Soil burn severity classes are described in Appendix A.

Table 1: Mountain Fire: Summary of Soil Burn Severity Acres

| Soil Burn Severity | Acres | Percent |
|---|---|---|
| Unburned/very low | 3,715 | 14 |
| Low | 9,872 | 36 |
| Moderate | 13,568 | 49 |
| High | 365 | 1 |

## Results of Sediment Yield Modeling

Erosion

The post-fire erosion risk was assessed using Rowe, Countryman and Storey (1949). Rowe, Countryman and Storey produced a classic study based on real data collected from many burned and unburned watersheds in Southern California. The Forest Service uses this model to estimate probable erosion rates from southern California watersheds as influenced by fire. Table 2 summarizes burned acres and erosion rates for "pourpoint" watersheds within the fire perimeter. Post-fire erosion is displayed in two columns, Erosion X normal and Sediment Deliver to "pourpoints". For a similar analysis of runoff discharge, please see the hydrology report.

The sediment yield model essentially erodes soil off the hillslopes into drainage ways, mobilizes sediment stored in the channels, and delivers the sediment to a point of interest or value. For example in Fobes Canyon at the Fire boundary, the model indicates that approximately 29 ac-ft of sediment may be delivered the first winter, over the course of one or more storms. One acre-foot is equivalent to a football field size area with one foot depth of sediment. At Fobes Ranch 5.6 ac-ft of sediment may be delivered to a point immediately above the Ranch structures. The model does not specify the size of storm. It is a probable output based on expected rates over a long period of time.

## Summary Post-fire Soil Conditions

- The overall average erosion rate for the Mountain Fire was 5 cubic yards per acre. In contrast, background erosion was estimated to be 0.7 cubic yards per acre.
- Hydrophobic soils were found in approximately 41% of the fire, or over 11,220 acres.
- Post-fire erosion rates may increase 21 fold over pre-fire condition in steeper watersheds with higher burn severity, i.e., Apple Canyon and Fobes Canyon.

**Table 2: Hydrologic Response by watershed within the Mountain Fire** (1st year)

| Watershed | Low + unburned (ac) | Moderate + high (ac) | Fraction of watershed burned mod&high | Erosion x backgrd | Sediment Delivery to "pourpoint" (ac-ft) |
|---|---|---|---|---|---|
| FOBES at RANCH HOUSE | 52 | 364 | 0.87 | 21.8 | 5.6 |
| APPLE CYN at ZEN CENTER | 74.8 | 463 | 0.86 | 21.5 | 7.1 |
| APPLE CYN above BONITA VISTA | 163.5 | 797 | 0.83 | 20.7 | 12.3 |
| ANDREAS CYN at Forest Bdy | 573.9 | 883 | 0.61 | 8.2 | 1.6 |
| COLDWATER CREEK | 1,647.60 | 501 | 0.23 | 6.5 | 8.7 |
| FOBES CANYON | 716 | 1,874 | 0.72 | 18.2 | 29 |
| HERKEYCREEK above PARK | 6,254.00 | 690 | 0.1 | 3.4 | 14.4 |
| K FLAT above CAMP | 689.1 | 206 | 0.23 | 6.5 | 3.6 |
| MURRAY CYN | 2,658.80 | 2,588 | 0.49 | 6.9 | 4.9 |
| TARQUITZ CREEK | 3,262.00 | 785 | 0.19 | 2.3 | 7 |
| WILLOW CREEK | 1,231.60 | 143 | 0.1 | 1.7 | 1.7 |
| WEST PALM CYN | 2,881.30 | 3,091 | 0.52 | 5.4 | 5.4 |
| | | | | | |
| Total acres | 20,205 | 12,385 | | | |
| Percent of area | 62% | 38% | | | |

## Emergency Determination

Risks to critical values are assessed with the BAER Risk Assessment matrix, shown in table 3. The probability of damage or loss of a critical value, and the associated magnitude of consequences lead to an overall risk to each critical value assessed below.

**Table 3 – BAER Risk Assessment**

| Probability of Damage or Loss | Magnitude of Consequences | | |
|---|---|---|---|
| | Major | Moderate | Minor |
| | RISK | | |
| Very Likely | Very High | Very High | Low |
| Likely | Very High | High | Low |
| Possible | High | Intermediate | Low |
| Unlikely | Intermediate | Low | Very Low |

**Values at Risk:**

**1. Threats to Soil Productivity and Hydrologic Function**

Table 2 displays the expected sediment delivery and how much erosion increase above pre-fire levels we expect fire-wide. The expected increase in hillslope erosion and sediment delivery is likely to impact values such as trails, roads, water quality and downstream flooding potential by increasing peak flows.

***May Valley***

In portions of the the May Valley area, there is an increased risk of rill and gully erosion resulting from the fire. Two soil types of concern are Wapi-Pacifico and Morical families (map units DxF and MoFG, respectively). These moderately deep soils that occur on decomposed granodiorite or old alluvial deposits were moderately burned in the fire and have near-complete removal of soil cover and chaparral vegetation. The combination of low soil cover, risk of gully erosion, high recreation use, and grazing pressure in the area constitute an increased risk to soil productivity in the May Valley area.

Probability of Damage or Loss: Reduced ground cover and a loss of protective vegetation in a grazing allotment and popular recreation area could lead to an unacceptable increase in gully and rill erosion before vegetation recovery occurs.

Magnitude of Consequence: Moderate. Increased gully erosion would cause considerable damage to soil productivity in the May Valley area, but the effects are not expected to be irreversible. Area closure and signage would maintain overall risk at or below an intermediate level.

Risk Level: Intermediate. The BAER team recommends administrative closures in the May Valley area to allow for natural recovery to occur. Temporary removal of grazing and recreation use in this area will allow for more rapid vegetation recovery and reestablishment of protective ground cover.

***Mountain Yellow-Legged Frog***

Increased erosion and sedimentation to streams in the Tahquitz watershed pose a potential risk to Mountain Yellow-Legged Frog occupied habitat. ERMiT and AGWA modeling of two subwatersheds that flow to occupied MYLF habitat show significant increases in erosion ranging from 19 to 26x times background levels in the first year post-fire, and remain elevated above background for at least 3 years. Additionally, ERMiT modeling on two site-specific high burn severity slopes above known occupied locations of MYLF showed there is a 50% probability that >1150 tons of sediment would be delivered just above occupied sites. High burn severity areas in the Tahquitz watershed were mapped in continuous patches, likely in dense stands of trees, and had complete canopy removal. These areas are expected to contribute excess sediment for several years, and all high burn patches in this area flow directly or indirectly into MYLF habitat. Lastly, when the initial BARC map was acquired, the upper portion of Tahquitz watershed was obscured by clouds, so soil burn severity in

the MYLF habitat was mapped by hand from a helicopter. It is likely that moderate burn is underrepresented in the final soil burn severity map because the dense overstory was still intact during the helicopter flight. Thus, total sedimentation to occupied MYLF habitat may be higher in year one (before complete needle cast occurs) than erosion models are predicting. Because of these factors, an emergency condition exists for the Mountain Yellow-Legged Frog.

Probability of damage or loss: Very Likely. The probability of significant sediment inputs to Willow Creek and the unnamed tributary east of Willow Cr. is very likely to continue well above natural levels for at least one year, and remain elevated for 3 years.

Magnitude of consequences: Moderate. Sediment inputs to stream channels are not likely to cause irreversible damage to the habitat for MYLF because *after revegetation occurs*, sedimentation will return to natural levels. However the soil scientists, hydrologist, and aquatic biologist on the team agree that there will be significant impacts to individual endangered frogs from excess sedimentation, that most suitable pool habitat will fill with sediment, significantly negatively impacting the MYLF population in the Tahquitz watershed.

Risk Level: Very High. The BAER team recommends salvage and captive breeding to protect this endangered species until the habitat recovers.

**2. Threats to Human Life and Property:** Based on expected watershed response there **is an emergency** threat to life and property.

***Zen Center***

The Zen Center is located in the upper reach of Apply Canyon where 87 percent of the upper watershed burned. The July monsoon storm event clearly showed that the structures close to the drainage are subject to flooding and deposition of sediment. See geology report for debris flow hazard.

Probability of Damage or Loss: Major. The hydrologic post fire response is expected to be quite significant at the Zen Center. Table 2 shows that 86 percent of the upper Apple Canyon watershed burned and sediment yield may be 21Xs background through the first winter. The RCS model predicted 7.5 ac-ft of sediment moved through (or deposited), along the channel the first winter. One acre-foot is equivalent to a football field with one foot depth of sediment. Post fire runoff for a 10 year storm event is expected to 1.8 Xs normal. See hydrology report for an estimate of peak flow increase.

Magnitude of Consequence: Major. The hydrologic post fire response is expected to be quite significant and there could be substantial damage to property and loss of life or injury.

Risk Level: Very High.

***Fobes Ranch***

The Fobes Ranch property sits at the base of the steep upper slopes of Fobes canyon on an alluvial fan, and receives runoff in a nearby stream channel from a ~430 acre moderately burned watershed. Approximately 90% of the steep hillslopes above Fobes Ranch were mapped with moderate soil burn severity, removing a significant portion of protective ground cover and increasing erosion potential. Moderately hydrophobic soils were noted during field surveys; in intense rain events the hydrophobicity is strong enough in Fobes Canyon to cause rill initiation, but not strong enough to completely prevent water infiltration. Thus, intense rain events that exceed the infiltration capacity of the soil are the most likely to cause excessive rill erosion, which could contribute to a damaging mudflow. Because of the high critical value at Fobes Ranch, three separate erosion models were used to assess the risk level of sedimentation to streams. All three models (ERMiT, RCS, and AGWA) predict highly elevated erosion rates and sediment delivery to the pourpoint above the ranch house (Table 2). ERMiT predicts that erosion levels will remain elevated and will have the potential to contribute to damaging mudflows for at least 3 years. This predicted increase in runoff and sediment loading in Fobes Canyon, combined with the close proximity of buildings to the Fobes channel justifies an emergency determination.

Probability of damage or loss: Very Likely. Flooding and hyperconcentrated flows (mudflows) resulting from increased erosion are very likely to damage private structures at Fobes Ranch.

Magnitude of consequences: Major. The predicted size of runoff events and the amount of material that could be deposited at Fobes ranch could cause substantial property damage, and may threaten life and safety of humans.

Risk Level: Very High. The BAER team recommends a point treatment on private land to directly protect life, safety, and property at Fobes Ranch. We believe treatments on private land in close proximity to structures at risk of flooding and sediment deposition would be more effective than a land treatment on Forest Service land. A discussion of why land treatments are not recommended in Fobes canyon is given below in the “Treatments to Mitigate the Emergency” section.

***Bonita Vista Ranch & Apple Canyon Ranch***

Two critical values in Apple Canyon below the Zen Center were assessed for risk of flooding, increased sedimentation, and property damage to houses and constructed dams. Constructed earthen dams at both the Apple Canyon Ranch (one dam) and at Bonita Vista Ranch (two dams) received significant sediment inputs from hyperconcentrated mudflows occurring in late July, 2013. The dam at Apple Canyon Ranch, which is upstream from Bonita Vista Ranch, was completely filled in with sediment and was overtopped by a mudflow. Additionally, water seepage was noted coming from the bottom of the dam. The existing condition of these dams, and the risk of future storms producing additional sediment delivery and high flows justifies an emergency determination at both locations. See Appendix C.

Apple Canyon Ranch
Probability of Damage or Loss: Likely. Damage or loss of the dam at Apple Canyon Ranch is likely due to the modeling data indicating a high probability of additional flood events with high peak flows.

Magnitude of Consequences: Moderate. Property damage would include potential dam failure, and resulting impacts to structures that are approximately .5 miles downstream from this dam (at Bonita Vista Ranch).

Risk Level: High. The BAER team recommends that the structural stability of the dam at Apple Canyon Ranch be assessed by a geotechnical or other appropriate engineer familiar with earthen dams. The risk of dam failure is closely tied to the risk level the team assigned to Bonita Vista Ranch.

*Bonita Vista Ranch*
Probability of Damage or Loss: Very Likely. Flooding and hyper-concentrated flows (mudflows) resulting from increased erosion are very likely to damage private structures at Bonita Vista Ranch. Possible dam failure upstream at Apple Canyon Ranch would significantly increase the probability of property damage, and was considered in our rating of very likely.

Magnitude of Consequences: Major. The predicted size of runoff events and the amount of material that could be deposited at Fobes ranch could cause substantial property damage, and may threaten life or injury to humans.

Risk Level: Very High. The BAER team recommends a point treatment on private land to directly protect life and property at Bonita Vista Ranch. We believe treatments on private land in close proximity to structures at risk of flooding and sediment deposition would be more effective than a land treatment on Forest Service land. A discussion of why land treatments are not recommended is given below in "Treatments to Mitigate the Emergency."

***Roads within the Fire***
*Apple Canyon Road above Bonita Vista Ranch (pvt)*
The Apple Canyon Road between Bonita Ranch and the Zen Center is a native surface road subject to flooding and loss of hydrologic function if the 2 culverts culverts and inside ditch plugged.

Probability of Damage or Loss: Major. The hydrologic post fire response is expected to be quite significant above the Bonita Ranch and the Zen Center. Table 2 shows that 86 percent of the upper Apple Canyon watershed burned and sediment yield may be 21Xs background through the first winter. Post fire runoff for a 10 year storm event is expected to 1.8 Xs normal. See hydrology report for an estimate of peak flow increase.

Magnitude of Consequence: Major. Storm damage to the road may *deny emergency access* in or out of the private land area.

Risk Level: Very High

*Fobes Canyon Road (6S05)*
The Fobes Canyon Road (FS ownership below Fobes Ranch private land) is a native surface road subject to post fire flooding.

Probability of Damage or Loss: Very Likely. The hydrologic post fire response is expected to be quite significant at Fobes Ranch and in the Fobes Canyon in general. Table 2 shows that 87 percent of the upper watershed burned and 72 percent of the whole watershed burned within the Fire boundary. Sediment yield is expected to be 18 to 21 Xs normal or background the first winter. Post fire runoff for a 10 year storm event is expected to 1.8 Xs normal. See hydrology report for an estimate of peak flow increase.

Magnitude of Consequence: Major. Storm damage to the road may *deny emergency access* in or out of the private land area.

Risk Level: Very High

*Other System Roads (5S01, 5S02, 5S05, 5S21)*
These are Forest System roads that the BAER engineer has identified as needing treatment to maintain hydrologic function.
Probability of Damage or Loss: Very Likely. The hydrologic post fire response is expected to be significant at drainage crossings in watersheds where these roads are located.

Magnitude of Consequence: Moderate. Storm damage to the road crossings, including culverts and road prisms may washout roads and cause gullies on the burned slopes below the road.

Risk Level: Very High.

*Johnson Meadow 5S05 spur (non-system)*
This is a non-system spur approximately 0.2 miles long that accesses the upper part of Johnson meadow from the east end. The meadow and some surrounding slopes burned. The road profile is entrenched (below grade) and has a small gulley down the middle. The non-system road is not a value at risk but the continued use of the spur will erode more sediment into the meadow where sensitive plants are located. The burned meadow itself is subject to vehicle damage with continued use of the spur.

Probability of Damage or Loss: Very Likely. Continued access to the meadow by OHV or other vehicles is very likely. The meadow is likely to be wetter than normal as a result of increased post fire runoff,

Magnitude of Consequence: Moderate. Un-authorized OHV or any vehicle ground disturbance will have a negative impact on meadow vegetation and soil, particularly if the meadow is wetter than normal.

Risk Level: Very High.

## Treatments to Mitigate the Emergency

### *Treatment Type – Closure*

The BAER team determined that recreation uses in the May Valley area, and grazing pressures in the Garner (also May Valley area) and Wellman allotments may delay the natural recovery of soil and vegetation conditions by increasing soil disturbance, and keeping ground cover at low levels. A temporary administrative closure is recommended to protect soil productivity, and to allow the area to stabilize before significant use and grazing continues. See Recreation specialist report (Trails), for specific treatment recommendations.

### *Fobes Canyon – No Land Treatment Proposed*

Because of the high risk of increased sedimentation in Fobes Canyon above the Ranch house, ERMiT was used to predict the potential effectiveness of a land treatment – spreading wood straw or mulch – to reduce sedimentation rates and peak flows. Figure 1 shows the sub-watershed that flows into the pourpoint above Fobes Ranch (in blue). The crosshatched area is designated as wilderness, and the red areas are slopes >60%. These areas represent ground that is not feasible to treat with mulch or wood straw. If eliminated, results from ERMiT show that only a 30% reduction in sediment production would be achieved by treating non-wilderness Forest Service ground that is <60% slope. If a treatment were done, this reduction in sediment would not be sufficient to reduce the risk of sedimentation and damaging mudflows.

The BAER Program requires that proposed treatments must be proven effective, technically feasible, justified by the values at risk, of a magnitude to make a meaningful difference to the resources, and natural recovery deemed inadequate. Proposed treatments are considered the minimum necessary response to significantly reduce the threat to the values at risk. Thus, in the Mountain Fire, no locations were identified as having emergency threats to values at risk with feasible hillslope treatment opportunities beyond point protection.

### *Forest System Road Treatments*

Accepted and economical BAER road treatments to mitigate the risks to life and safety and facilitate the administrative closure on road segments of 5S02, 5S05, 5S21, and 6S05 include replacing existing and installing new standard traffic control gates at the beginning of main road entry points of the burn area, installation of vertical riser pipes, metal end sections, metal overside drains, rolling dips, drainage armor, storm proofing and storm inspection and response.

### *Johnson Meadow 5S05 spur (non-system) Treatment*

The spur will be blocked with boulders to prevent access to the burned meadow. See Engineering and Botany report for details.

## Protection/Safety Treatments:

***Private Lands Subject to Flooding in Apple Canyon and Fobes Canyon***
Some private lands in Apple Canyon and Fobes Canyon do have a very high risk level for life and property and *warrant an emergency determination*. The Forest Service can not recommend treatments or expend BAER funds on private lands for treatments (FS has no authority on private lands). BAER can report findings of expected watershed response to landowners, the public or to agencies. This is largely done through the process of Interagency Coordination.

***Interagency Coordination***
Interagency coordination started during the fire and continued throughout the BAER Assessment and is a critical component to the BAER process. Continuing this coordination by providing the BAER Assessment Report, specialist reports and attending meetings is anticipated. Public meetings are scheduled for the near future. Continued coordination is needed for the following values at risk:

- Zen Center – Apple Canyon
- Bonita Vista Ranch – Apple Canyon
- Fobes Ranch – Fobes Canyon.
- Natural Resourse Conseration Serive (NRCS) may recommend treatments on private lands.
- Riverside County OES/ NOAA- reverse 911 calls for significant precipitation events for private property owners listed above.
- We also anticipate the interagency coordinator will respond to media inquiries regarding the BAER report.

## Discussion/Summary/Recommendations

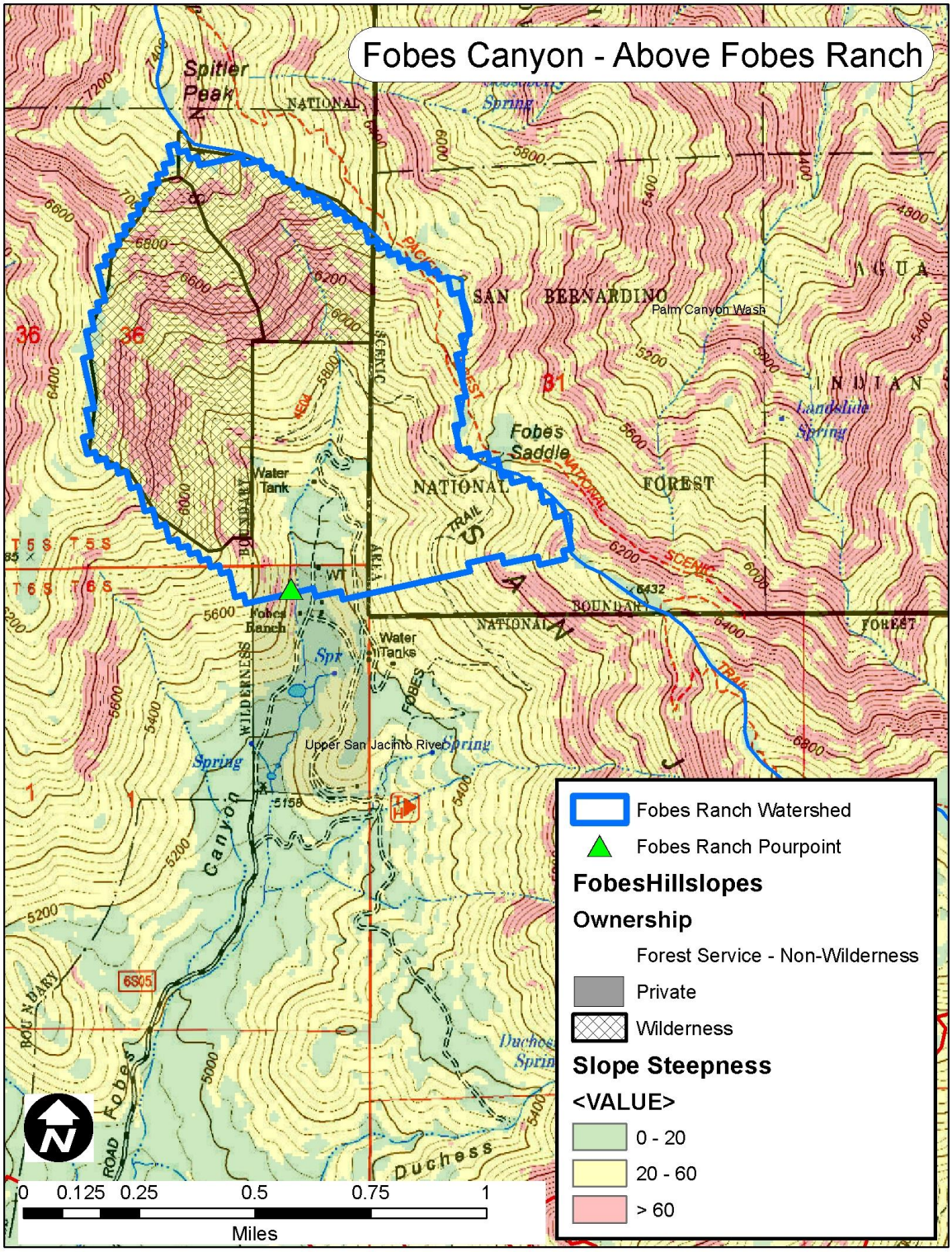
Fobes Canyon watershed and upper Apple Canyon watershed are expected to have a large post fire sediment and flooding response. The BAER Team recognizes that accelerated erosion from high and moderate burn severity areas can lead to adverse conditions to identified values at risk. Possible hillslope treatments were fully explored with known and valid criteria applied to determine suitability

No treatment was recommended on Forest Service lands above Fobes Ranch or Apple Canyon. The small percentage of FS lands in Apple Canyon above the Zen Center is simple too steep to treat successfully. A treatment to aerial mulch a woodstraw product was considered above Fobes Ranch. Much of the watershed is untreatable because of steep slopes and the fact that much of the Forest Service land is in wilderness. Treating the remaining acres would fail to reduce runoff and sedimentation enough. *This reduction or benefit from aerial mulching should not be seen as "fixing the emergency".* Direct on-site measures would still be necessary at Fobes Ranch to direct peak sediment flows safely.

Accelerated erosion is expected to occur for up to five years, with the majority of erosion and sedimentation occurring the first and second winter. Trails on steep granitic terrain (PCT and others) are subject to filling in or obliteration by dry ravel processes, almost immediately. Trail treatments including closure are recommended but slopes will only become stable once the native vegetation and roots are fully established.

Much of the native plant cover in the Mountain Fire is chaparral. Chaparral vegetation responds quickly after fire providing canopy and soil cover. A U.S. Geological Survey study found that minimal additional siltation (2$^{nd}$ year erosion), occurred in Los Padres Reservoir during monitoring of winter runoff of 1978 and 1979 (USGS, 1979). USGS (1979) concluded that very rapid revegetation of burned slopes helped to reduce erosion to pre-fire rates. See the hydrology and geology reports for additional information on post-fire stream channel processes and debris flow processes.

Figure 1 – Fobes Canyon



## References

Rowe, P.B., C.M. Countryman and H.C. Storey. 1949. Probable peak discharges and erosion rates from southern California watersheds as influenced by fire. U.S. Department of Agriculture, Forest Service. California forest and Range Experiment Station.

USGS, 1979, Sedimentation Study of Los Padres Dam—1979 Update: Report for Monterey Peninsula Water Management District, April, 1979.

USFS BAER Web site: http://fsweb.gsc.wo.fs.fed/baer
USFS BAER Manual FSM 2523 (see USFS BAER web site)

## Mountain BAER Soil Report
## Appendix A

### Burn Severity Criteria

Parsons, A. (2002)

FSH 2509.23.31,32 contains guidelines discussing site indicators to use in determining these classes. The Interagency BAER/ESR Handbook also contains some definition guidelines. Keep in mind that these are only guidelines, and each fire/ecosystem situation can be different. You may observe other characteristics that will help you determine how to map a given area. Develop familiarity with the specific ecosystems of your burned area, and learn to judge characteristics that indicate the level of burn severity.
There are some relatively minor differences in the various class definitions that the Handbooks endorse. Become familiar with them and work with your team leader to decide what makes sense to use in your area. In general, the guidelines can be summarized as follows:

**UNBURNED**; This one is obvious. The polygon has not been burned.

**LOW**; The majority of the polygon has not been significantly altered by the fire. Significant amount of remaining intact or singed leaf litter and duff remain, ash is sparse, small unburned fuels remain, canopy is largely intact, grass and shrub root crowns are intact. Areas where pre-fire vegetation was sparse, and/or bare soil and rock fragments dominate should be classified as Low severity, since there was little fuel to burn to begin with. Low severity burn areas do not contribute to an emergency watershed condition, but they may act as buffer areas to mitigate flood hazards that originate on more severely burned areas. Overstory mortality is generally minimal but can be significant in some cases.

**MODERATE**; This class is the most difficult to define, but think of it as intermediate between LOW and HIGH. Its specific characteristics may vary depending on the ecosystem types involved in the fire area. Less than 40 percent of the area exhibits high severity characteristics. During triage, areas of MODERATE severity are not as likely to be prime candidates for emergency stabilization treatments, but a rating of moderate alerts the team to the possibility that the area may be a potential flood source area. The site is somewhat altered by fire. Overstory mortality may be moderate to high, where brown needles remain but trees are dead.

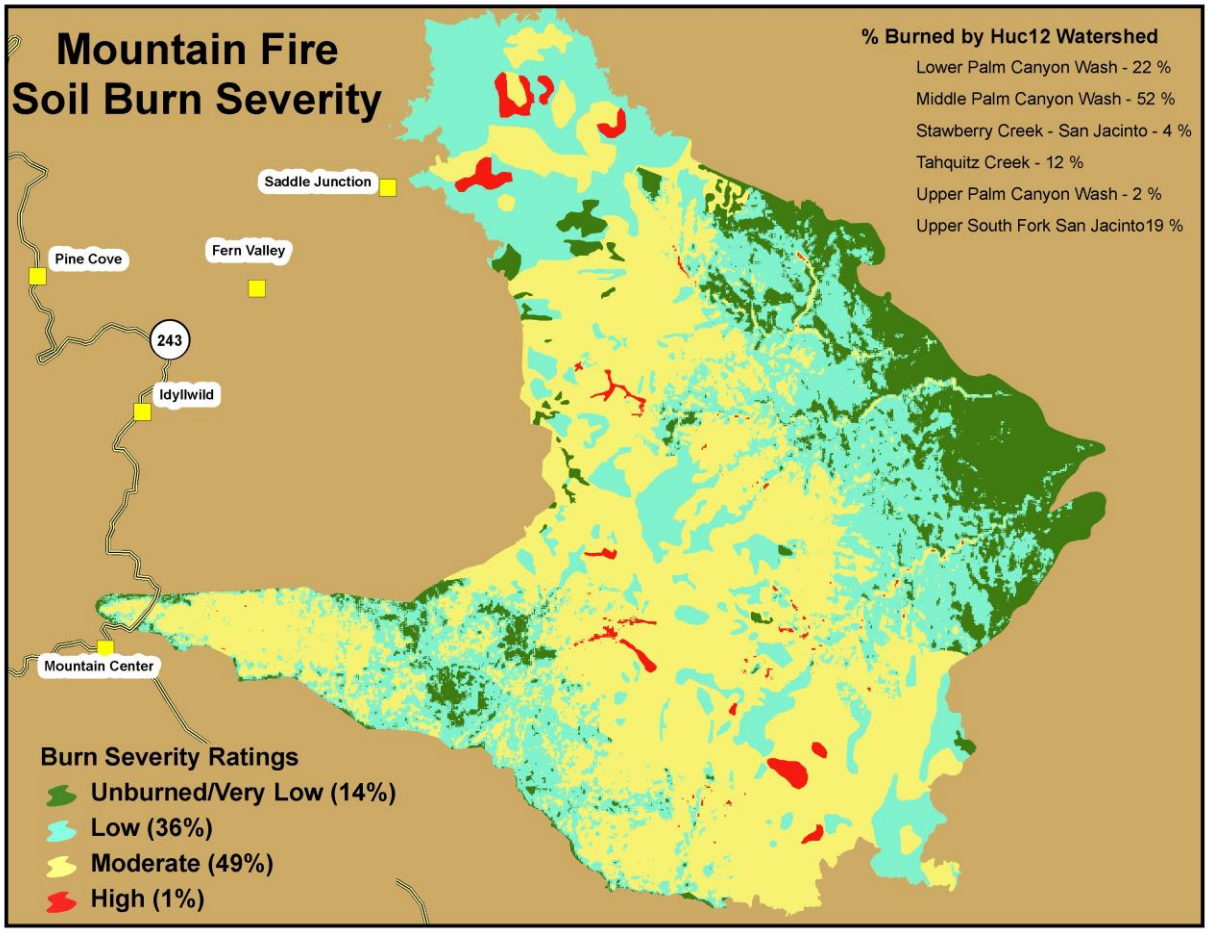
In forested areas, generally litter is consumed and duff deeply charred or consumed, but recognizable char and some unburned remnants of leaf or needle litter and duff may remain. Ash and char are present. Soil characteristics are not significantly visibly altered. Fine and very fine roots and soil structural aggregates are still intact in the soil surface. On shrub or grassland sites, canopy is consumed and ash may replace the usually sparse pre-fire leaf litter. Evidence of unburned litter is found under a thin ash or char layer. Shrub skeletons remain but leaves and fine twigs are consumed. Water repellency may be observed in places, but other factors such as remaining ground cover or needle cast potential, or rapidly resprouting vegetation will help to mitigate runoff to some extent. Generally, runoff response is significantly accelerated as a result of the fire for the first year only on moderate severity shrub sites. Runoff in subsequent years is mitigated by vegetation recovery.

A situation that often causes confusion in burn severity mapping is an area where you may find forested areas where duff and litter have mostly been consumed, but small fuels and needles remain in the canopy. Even though these needles may be brown and dead, they will quickly fall and create a natural mulch, or ground cover. This natural mulch will act to moderate soil surface temperature and moisture, add native organic matter, and protect the soil from raindrop splash and runoff. Replenishing ground cover is the least expensive and single most effective treatment we can implement on a burned area, and during triage for treatment recommendations, these areas with natural mulch potential are not likely to be high priority for treatment. It will usually be classified as "Moderate", especially if you can identify intact soil structure or fine roots, and at least some remnants of charred duff and litter.

**HIGH**; The site has been significantly affected by the fire. In general, areas where pre-fire vegetation, ladder fuels, and litter layers are thick, heat residence time is often long. More than 40 percent of the area exhibits characteristics of high severity. The area is classified as high burn severity if duff and litter layers have been completely consumed to ash such that little or no effective ground cover remains, surface soil is often loose, single grained with little sign of intact structure or fine roots. (It is important to compare to unburned areas, since sometimes this is the natural condition.) Soil structure is often destroyed, and fine roots in surface soil have been consumed. Surface soil which, prior to the fire, may have had stable granular structure can, after a high severity burn, be loose and single grained, due to volatilization of roots and binding organic compounds. Water repellency may or may not be significant, but is often increased after a high severity burn. (Water repellency alone is not necessarily an indicator of high severity, nor is it required for a classification of HIGH severity.) Use multiple indicators rather than just one or two. The size of fuels remaining is generally large - all fine fuels have been consumed. In other words, the only stuff remaining is big stuff. The soil hydrologic function has been significantly altered. Little or no ground cover or litter remains, and trees are black sticks with no needlecast/mulch potential. Runoff and erosion will be significant. Canopy and small to medium or even large fuels are usually consumed. Natural recovery of vegetation may be inhibited. Overstory mortality is generally high, up to 100%.

The appearance and characteristics of HIGH severity may vary from ecosystem to ecosystem, thus it is difficult to give a hard and fast definition. Sometimes ash color can indicate heat of consumption; white ash may indicate more complete consumption, but some vegetation species tend to produce white ash as well, so ash color by itself is not a reliable indicator. Plenty of areas with black or gray ash are high severity. Grass or shrub root crowns may have been consumed and natural resprouting and revegetation may be inhibited.

**Mountain BAER Soil Report**
**Appendix B**



**Mountain BAER Soil Report**
**Appendix C**

Dam at Apple Canyon Ranch –Pond behind dam filled in with sediment & was overtopped by a hyperconcentrated mudflow.

Structure adjacent to stream at Bonita Vista Ranch (in Apple Canyon), and sediment deposited in stream.